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Research Article

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Effect of organic manures on growth and yield of cashew cv. VENGURLA-4 under Konkan region of Maharashtra

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Summary

An experiment on the effect of organic manures on growth and yield of cashew cv. VENGURLA-4 under Konkan region of Maharashtra was conducted under AICRP-Cashew programme during 2011-12 to 2014-15 at Regional Fruit Research Station, Vegurle-416 516, dist. Sindhudurg (M.S.). Uniform eight months old grafts of cashew (V-4) were planted at 7m x 7m during 2008. The experiment was laid out in Randomized Block Design with three replications and eight treatments (T_1-100 % N as FYM, T_1 + biofertilizers consortium (BCF) (200g/tree), T_3- 50% N as FYM + BCF (200g/tree) + rock phosphate, T_4- 100% N as vermicompost + BCF (200g/tree), T_5- recycling of organic residue with the addition of 20 per cent cow dung slurry (20% weight of organic residue as cow dung slurry), T_6- *In situ* green manuring/green leaf manuring to meet 100% (retain litter + planting cowpea) T_7- 25% N as FYM + recycling of organic residues + *In situ* green manuring/green leaf manuring + BCF (200g/tree) and T_8- control- recommended dose of fertilizer + 10 kg FYM). All the observations were recorded at appropriate stages. Similarly uniform package of practices were simultaneously followed. The data were statically analyzed as per procedure. Among the different organic manures tested, application of 50% N as FYM + BCF (200g/tree) + rock phosphate (T_3) recorded maximum number of panicles/m^2 (17.53/m^2) followed by T_8 – control *i.e.* recommended dose of fertilizer + 10 kg FYM (16.58/m^2) and T_6 - *In situ* green manuring/green leaf manuring to meet 100% (retain litter + planting cowpea) (16.32/m^2). While, application of recommended dose of fertilizer + 10 kg FYM (T_8- control) recorded significantly the maximum mean pooled yield of 4.8 kg/tree and superior over the rest of the treatments.

Key words : Cashew, *In situ* leaf manuring, Organic manures, Apple weight, Yield

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Introduction

Cashew is one of the important dollar earning crops of India. During 2012-13, with total production of cashew in the country was 7.28 lakh tonnes from 9.82 lakh ha of land with a productivity of 772 kg/ha. Although Andhra Pradesh has the largest area under cashew, Maharashtra ranks first in both production and productivity (Anonymous, 2012). The productivity of cashew in the country is highest in Maharashtra. This is because of

the fact that in Maharashtra, major plantations have been established with high yielding varieties. In order to get better yield, it is essential to maintain adequate N:P:K ratio in the soil. Application of 10-15 kg of farmyard manure per plant is recommended to ensure adequate organic matter in the soil. The fertilizers recommended for a 4 year and onward age of cashew tree are 1000 g N (2.1 kg urea), 250g P_2O_5 (1.56 kg single super phosphate and 250 g K_2O (400 g muriate of potash). Integration of inorganic and organic nutrient inputs could, therefore, be considered as a better option in increasing fertilizer use efficiency and providing a more balanced supply of nutrients. Vanlauwe *et al*. (2002) reported that combination of organic and inorganic nutrient sources result into synergy and improved conservation and synchronization of nutrient release and crop.

Various studies have demonstrated that the cashew tree responds to the application of mineral nutrients, though the responses are significantly affected by plant age, the genotype utilized, the conditions of cultivation, soil and climate and of the crop management (Barros *et al*., 1984; Ghosh, 1990; Ximenes, 1995; Bezerra *et al*., 1999 and Crisóstomo *et al*., 2005). Organic materials (both organic manures as well as organic wastes) for improving the physical properties of soils that allows profitable crop production (Somani and Totawat, 1996). According to Ojeniyi (2000), published works on the organic manure use in Nigeria is rather scanty. The need to use renewable forms of energy and reduce costs of fertilizing crops has revived the use of organic fertilizers worldwide. Improvement of environmental conditions and public health are important reasons for advocating increased use of organic materials (Seifritz, 1992 and Maritus and Vlelc, 2001).

In most of the state cashew is found as a default organic crop in which no application of manure and fertilizers, this is also one of the reasons for low cashew production in the country. In our country, application of manures and fertilizers is very limited in the case of cashew. Under this situation, it is necessary to access the effect of different organic manures either alone or in integrations on growth, yield and quality of cashew. Hence, the trial was initiated on organic management of cashew was undertaken under AICRP-Cashew programme with an object to evaluate and standardize an organic management schedule for cashew cultivation to optimize the returns and to work out economic feasibility of organic farming systems over conventional farming.

Resource and Research Methods

An experiment on effect of organic manure on growth and yield of cashew initiated at Regional Fruit Research Station, Vengurle under AICRP-Cashew programme during 2007-08 to 2014-15 with an object to access the feasibility of different organic manures on growth and yield of cashew. The uniform eight months old grafts of cashew cv. VENGURLA-4 were planted at 7 x 7m during the year 2007-08. The experiment was laid out in Randomized Block Design with three replications and 8 treatments (T_1-100 % N as FYM, T_2-100% N as FYM + biofertilizers consortium (BCF) (200g/tree), T_3-50% N as FYM + BCF (200g/tree) + rock phosphate, T_4-100% N as vermicompost + BCF (200g/tree), T_5-recycling of organic residue with the addition of 20 per cent cow dung slurry (20% weight of organic residue as cow dung slurry), T_6- *In situ* green manuring/green leaf manuring to meet 100 per cent (retain litter + planting cowpea) T_7- 25% N as FYM + recycling of organic residues + *In situ* green manuring/green leaf manuring + BCF (200g/tree) and T_8- control (recommended dose of fertilizer + 10 kg FYM). The initial soil nutrient status of the experimental plot and treatment-wise soil nutrient status after harvest of crop was estimated. All the observations were recorded at appropriate stages. Similarly uniform package of practices were simultaneously followed. The data was statically analyzed as per procedure given by Panse and Sukhatme (1985). The physical properties were estimated by adopting standard method as mentioned by Black (1965) and Piper (1966) and chemical properties were estimated by using Jackson (1973) and Bray and Kurtz (1945) as well as given by Subbiah and Asija (1956) and Tondon (1993). However, the available micro-nutrients were estimated by adopting standard method given by Lindsay and Norvell (1978).

Research Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Initial soil characteristics :

Data presented in Table 1 indicated that the soil of the experimental site was lateritic clay loam in texture

and moderately acidic (pH 5.40) in reaction and showed safe limit of electrical conductivity (0.08dSm^{-1}) for plant growth. Soil was high in organic carbon content, medium in available nitrogen content (300.20 kg ha^{-1}) and available phosphorus content (20.84 kg ha^{-1}). It showed moderately high content of available potassium (2168.80 kg ha^{-1}). As far as the micronutrients in soil were concerned, it indicated sufficient range of available iron (52.92 ppm), manganese (75.15 ppm), copper (2.98 ppm) and zinc (0.67 ppm) content. The similar finding in respect of initial soil properties of lateritic soil were also reported by Shinde *et al*. (2010).

Table 1: Initial soil properties of the experimental site

Sr. No.	Properties	Content
1.	pH (1:2.5)	5.40
2.	EC dS m^{-1}	0.08
3.	MWHC %	42.0
4.	Bulk density Mgm^{-3}	1.19
5.	Particle density Mgm^{-3}	2.47
6.	Organic carbon g kg^{-1}	14.80
7.	Available N kg^{-1}	300.2
8.	Available K_2O kg^{-1}	268.8
9.	Available P_2O_5 kg^{-1}	20.84
10.	Zn (ppm)	0.668
11.	Cu (ppm)	2.98
12.	Fe (ppm)	52.92
13.	Mn (ppm)	75.15

The various parameters such as flowering duration (days), number of lateral and panicles/m^2, number of fruit set/m^2, number of nuts/panicle, nut weight (g), apple weight (g), yield (kg/tree) and shelling (%) during the period under investigation (2011-12-01 to 2014-2015) were recorded, data were statically pooled analyzed and presented in Tables 1 to 4. Similarly, treatment-wise soil nutrient status estimated after harvest is given in Table 5.

Effect of organic manures on flowering duration and production of laterals and panicle/m^2 :

The four years pooled data (2011-12 to 2014-15) are presented in Table 2 which revealed that, the various organic treatments did not significantly affect the flowering duration and production of laterals/m^2 of cashew. However, the organic treatments significantly influenced the production of panicles/m^2 of cashew cv. VENGURLA-4. Treatment T_3 (50% N as FYM + BCF (200g/tree) + rock phosphate) recorded significantly

Table 2: Effect of organic manures on growth and flowering and attributes of cashew during the year 2011-12 to 2014-15

Treatment details		Mean flowering duration (days)					Mean laterals/m^2					Mean flowering panicles/m^2				
		2011-12	2012-13	2013-14	2014-15	Pooled mean (4 years)	2011-12	2012-13	2013-14	2014-15	Pooled mean (4 years)	2011-12	2012-13	2013-14	2014-15	Pooled mean (4 years)
T_1	100 % N as FYM	116.70	109.40	103.50	109.70	109.82	28.17	29.80	25.83	25.50	27.32	16.33	15.33	15.08	15.58	15.58
T_2	100% N as FYM + biofertilizers consortium (BCF) (200g/tree)	119.80	110.10	105.30	110.33	111.37	30.08	31.07	24.92	27.58	28.41	17.67	15.03	15.17	16.25	16.03
T_3	50% N as FYM + BCF (200g/tree) + rock phosphate	114.60	120.50	100.60	105.70	110.35	29.42	30.97	23.67	27.39	27.86	17.58	15.90	16.92	19.72	17.53
T_4	100% N as vermicompost + BCF (200g/tree)	118.30	121.50	105.40	108.00	113.30	23.50	30.00	26.08	25.75	26.33	15.50	14.63	15.58	15.42	15.28
T_5	Recycling of organic residue with the addition of 20 % cow cung slurry (20% weight of organic residue as cow cung slurry)	119.90	119.30	103.30	107.30	112.45	27.50	29.23	25.00	26.75	27.12	15.75	13.57	15.93	15.67	15.22
T_6	*In situ* green manuring/green leaf manuring to meet 100% (Retain litter +planting cowpea)	121.00	119.30	100.80	102.70	110.95	29.0	29.80	31.33	27.75	29.47	17.08	15.37	17.42	15.42	16.32
T_7	25% N as FYM + recycling of organic residues + *In situ* green manuring/green leaf manuring + BCF (200g/tree)	120.40	107.00	98.40	102.30	107.02	27.25	30.80	26.00	26.67	27.68	14.75	15.53	15.33	16.58	15.54
T_8	Recommended dose of fertilizer +10 kg FYM (Control)	123.00	110.80	103.50	108.70	111.50	29.08	31.57	26.58	28.83	29.01	17.42	16.07	14.58	18.25	16.58
	S.E. ±					1.88					0.76					0.48
	C.D. (P=0.05)					NS					NS					1.41

NS= Non-significant

Table 3 : Effect of organic manures on fruiting attributes of cashew during the year 2011-12 to 2014-15

Treatment details		Mean fruit set/m²				Pooled Mean (4 years)	Mean no. of nuts/panicle				Pooled mean (4 years)	Mean nut wt. (g)				Pooled mean (4 years)
		2011-12	2012-13	2013-14	2014-15		2011-12	2012-13	2013-14	2014-15		2011-12	2012-13	2013-14	2014-15	
T_1	100 % N as FYM	22.6	39.4	20.2	44.9	31.7	2.9	14.5	5.6	8.5	7.9	8.0	8.2	7.8	8.8	8.2
T_2	100% N as FYM + biofertilizers consortium (BCF) (200g/tree)	30.6	40.3	33.8	46.4	37.7	4.1	14.2	5.6	9.2	8.3	8.5	8.6	8.6	9.1	8.7
T_3	50% N as FYM + BCF (200g/tree) + rock phosphate	23.2	37.1	31.9	48.0	35.0	2.6	14.7	5.1	9.3	7.9	9.1	8.2	8.5	8.8	8.6
T_4	100% N as Vermicompost + BCF (200g/tree)	23.2	40.9	31.4	53.3	37.2	3.2	14.8	5.6	9.4	8.2	8.6	7.6	8.1	9.1	8.3
T_5	Recycling of organic residue with the addition of 20 % cow dung slurry (20% weight of organic residue as cow dung slurry)	22.5	43.4	37.8	41.3	36.3	2.4	16.0	5.8	7.4	7.9	8.3	7.7	8.3	9.1	8.3
T_6	*In situ* green manuring/green leaf manuring to meet 100% (retain litter +planting cowpea)	36.8	38.3	34.3	43.6	38.2	4.7	14.3	5.7	8.5	8.3	8.8	8.0	9.0	9.1	8.7
T_7	25% N as FYM + recycling of organic residues + *In situ* green manuring/green leaf manuring + BCF (200g/tree)	25.8	40.2	40.4	47.9	38.5	3.4	15.7	4.5	8.4	8.0	9.1	8.3	8.2	8.9	8.6
T_8	Recommended dose of fertilizer + 10 kg FYM (Control)	27.2	38.8	31.0	54.2	37.8	3.6	13.7	6.0	10.1	8.3	8.3	8.3	8.7	9.3	8.6
	S.E. ±					2.31					0.39					0.15
	C.D. (P=0.05)					NS					NS					NS

NS= Non-significant

Table 4: Effect of organic manures on yield parameters of cashew during the year 2011-12 to 2014-15

Treatment details		Apple wt. (g)				Pooled Mean (4 years)	Yield (kg/tree)				Pooled Mean (4 years)	Shelling (%)				Pooled mean (4 years)
		2011-12	2012-13	2013-14	2014-15		2011-12	2012-13	2013-14	2014-15		2011-12	2012-13	2013-14	2014-15	
T_1	100 % N as FYM	63.1	63.5	65.1	90.8	70.6	3.2	2.9	2.0	3.1	2.8	29.8	29.5	29.8	29.0	29.5
T_2	100% N as FYM + biofertilizers consortium (BCF) (200g/tree)	73.5	68.0	61.3	92.5	73.8	4.6	3.8	2.6	2.7	3.5	29.5	29.3	28.7	29.0	29.1
T_3	50% N as FYM + BCF (200g/tree) + rock phosphate	76.8	64.3	63.4	90.0	73.6	3.5	2.7	2.1	4.3	3.1	28.5	28.5	28.5	29.5	28.7
T_4	100% N as vermicompost + BCF (200g/tree)	67.7	68.5	67.8	101.7	76.4	2.8	2.6	1.5	4.0	2.7	28.8	26.7	28.7	29.7	28.4
T_5	Recycling of organic residue with the addition of 20% cow dung slurry (20% weight of organic residue as cow dung slurry)	71.9	70.1	72.5	93.3	76.9	2.0	2.0	1.1	3.1	2.1	29.8	29.5	29.2	29.2	29.4
T_6	*In situ* green manuring/green leaf manuring to meet 100% (Retain litter +planting cowpea)	77.0	65.2	66.0	86.7	73.7	4.1	2.9	2.2	3.5	3.2	29.2	29.3	29.0	28.5	29.0
T_7	25% N as FYM + recycling of organic residues + *In situ* green manuring/green leaf manuring + BCF (200g/tree)	70.5	63.3	73.3	98.3	76.3	2.8	3.7	1.5	4.7	3.2	28.8	29.3	28.7	29.3	29.0
T_8	Recommended dose of fertilizer + 10 kg FYM (Control)	65.3	64.7	78.0	101.7	77.4	4.9	5.1	2.3	6.9	4.8	29.2	30.0	29.2	29.7	29.5
	S.E.±					2.59					0.34					0.29
	C.D. (P=0.05)					NS					1.02					NS

NS=Non-significant

maximum number of panicles/m^2 (17.53/m^2) and at par with treatment T_8 – control *i.e.* recommended dose of fertilizer + 10 kg FYM (16.58/m^2) and T_6 - *In situ* green manuring/green leaf manuring to meet 100 per cent (retain litter + planting cowpea) (16.32/m^2).

Effect of organic manures on fruit set/m^2, number of nuts/panicle and nut weight (g) :

The data in respect of pooled mean on fruit set/m^2, number of nuts/panicle and mean nut weight showed non-significant results (Table 3). The non-significant results may be due to the experiment which was in initial stage and the availability of nutrients through organic source may require optimum period for their availability in the soil and further absorption of nutrient by the plant during establishment period of the plants.

Effect of organic manures on apple weight, yield and shelling (%) of cashew cv. VENGURLA-4 :

The four years pooled data presented in Table 4 revealed that the application of various manures through both organic and inorganic sources significantly affect the yield of cashew cv. VENGURLA-4, however, did not showed significant results for apple weight and shelling (%). Results indicated that all the fertilizer materials positively and significantly ($p > 0.05$) increased the yield considered.

Application of recommended dose of fertilizer + 10 kg FYM (control) recorded significantly the maximum mean pooled yield of 4.8 kg/tree and superior over the rest of the treatments. The present results might be due to cashew gives very good response to chemical fertilizers. When the fertilizer given through inorganic source in the soil that lead to immediate and readily available of nutrients that further help in more photosynthesis and dry matter production that might be significantly increased the yield in T_8 treatment as compared to rest of the other organic manure treatments. The present results are in the line with findings of Suge *et al*. (2011) who reported that increasing the inorganic fertilizers from 50 per cent to 100 per cent research recommended rates leads to direct increased growth and yield and fruit quality parameters of eggplant. However, on contrary, Lal *et al*. (2012) reported that highest fruit yield (125.06 kg/tree) in soil application of vermicompost @ 75kg/tree, followed in application of poultry manure @ 75kg/tree (124.23 kg/tree), while the lowest was recorded in control (110.24 kg/tree).

In the present investigation the effect of application of organic manures on flowering duration, production of laterals, fruit set/m^2, number of nuts/panicle, nut and apple weight (g) of cashew cv. VENGURLA-4 was not significant ($P<0.05$) and was attributed to probably a slow rate of mineralization. The depression in values of yield of cashew in other organic treatments might be due to the fact that some of the nutrients applied to the soil were immobilized by soil micro-fauna, soil organic matter and other edaphic factors thereby making them unavailable to the cashew. This observation is consistent with the findings of Ibiremo *et al*. (2012).

Effect of organic manures on NPK status of soil after crop harvest :

The data presented in Table 5 revealed that, T_4

Table 5: Soil analysis of cashew under organic management trial at Vengurle centre during the year 2014-15

Treatment details		pH	EC	OC (%)	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
T_1	100 % N as FYM	4.90	0.068	1.79	269.69 (L)	28.13 (H)	407.99(VH)
T_2	100% N as FYM + biofertilizers consortium (BCF) (200g/tree)	5.06	0.064	1.36	241.47 (L)	28.67 (H)	247.69
T_3	50% N as FYM + BCF (200g/tree) + rock phosphate	4.97	0.031	1.59	332.42 (M)	27.58(MH)	271.95(H)
T_4	100% N as vermicompost + BCF (200g/tree)	4.64	0.034	0.93	338.69 (M)	28.87(H)	253.52(H)
T_5	Recycling of organic residue with the addition of 20 % cow dung slurry (20% weight of organic residue as cow dung slurry)	4.93	0.026	0.19	268.71 (L)	29.97(H)	345.80(VH)
T_6	*In situ* green manuring/green leaf manuring to meet 100% (retain litter +planting cowpea)	5.14	0.019	0.42	244.61 (L)	26.50(MH)	268.15(H)
T_7	25% N as FYM + recycling of organic residues + *In situ* green manuring/green leaf manuring + BCF (200g/tree)	4.87	0.029	1.01	335.55 (M)	26.28(MH)	468.69(VH)
T_8	Recommended dose of fertilizer + 10 kg FYM (Control)	5.84	0.023	1.20	319.87 (M)	26.93(MH)	211.79(MH)
	S.E.±				6.98	0.479	12.00
	C.D. (P=0.05)				21.19	1.454	36.42

(100% N as vermicompost + BCF (200g/tree) recorded significantly maximum available soil N (338.69 kg/ha) and at par with T_7 (335.55 kg/ha), T_3 (332.45 kg/ha) and T_8 (319.47kg/ha) while, available P_2O_5 was found significantly maximum in T_5 (29.97 kg/ha) and at par with T_4 (28.87 kg/ha) and T_2 (28.67 kg/ha). Whereas, available K_2O recorded sinficantly maximum in T_7 (468.69 kg/ha) and superior over rest of the treatments.

Conclusion :

Among the different organic manures tested, application of 50 per cent N as FYM + BCF (200g/tree) + rock phosphate (T_3) recorded maximum number of panicles per m^2 (17.53/m^2) followed by T_8 – control *i.e.* recommended dose of fertilizer + 10 kg FYM (16.58/m^2) and T_6 - *In situ* green manuring/green leaf manuring to meet 100 per cent - retain litter + planting cowpea (16.32/m^2). While, application of recommended dose of fertilizer +10 kg FYM (T_8-control) gave highest pooled yield of 4.8 kg/tree and showed its superiority over the rest of the treatments.

On the basis of the results obtained, it is clearly indicated that only the organic sources can not maintain instant flow of nutrients in increasing crop yield. There is need to use organic and chemical fertilizers in combination so as to increase crop productivity.

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